FINAL REVISED PROPOSED PLAN TO ADDRESS ZONE C, OPERABLE UNIT 11

F. E. WARREN AIR FORCE BASE, WYOMING

REVISED PROPOSED PLAN

Zone C, Operable Unit 11 (OU11), at F. E. Warren AFB, Wyoming (FEW) consists of the former Landfill 3 (LF3) and the groundwater contaminated by LF3. A final Zone C Record of Decision (ROD) was signed in September 2001. The original remedy for this site was to pump the groundwater and treat it before discharge. Field testing in 2002 demonstrated that most of the area of contamination cannot be effectively pumped. As a result, the original remedy needed to be reconsidered, which is summarized in a Supplemental Feasibility Study (SFS) completed in 2003. This revised proposed plan summarizes the results of the SFS and proposes a new remedy for cleaning up the groundwater at LF3.

The United States Air Force (USAF), in consultation with the U. S. Environmental Protection Agency (EPA) and the Wyoming Department of Environmental Quality (WDEQ), will select a final remedy for the site after reviewing and considering all information submitted during the 30-day public comment period. The Preferred Alternative may be modified, or replaced by one of the other alternatives, based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Revised Proposed Plan.

The USAF has prepared this Revised Proposed Plan as part of its public participation responsibilities under Section 300.430(f)(2) of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The Revised Proposed Plan is issued by the USAF. EPA is the lead regulatory agency and WDEQ is the support regulatory agency.

Dates to Remember

PUBLIC COMMENT PERIOD : 9 March – 8 April 2004

F. E. Warren Air Force Base will accept written comments on the Revised Proposed Plan during the public comment period.

PUBLIC MEETING: 23 March 2004 at 7:00 p.m. at Little America Hotel & Resort, 2800 West Lincolnway, Cheyenne, Wyoming

F. E. Warren Air Force Base will hold a public meeting to explain the Revised Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting.

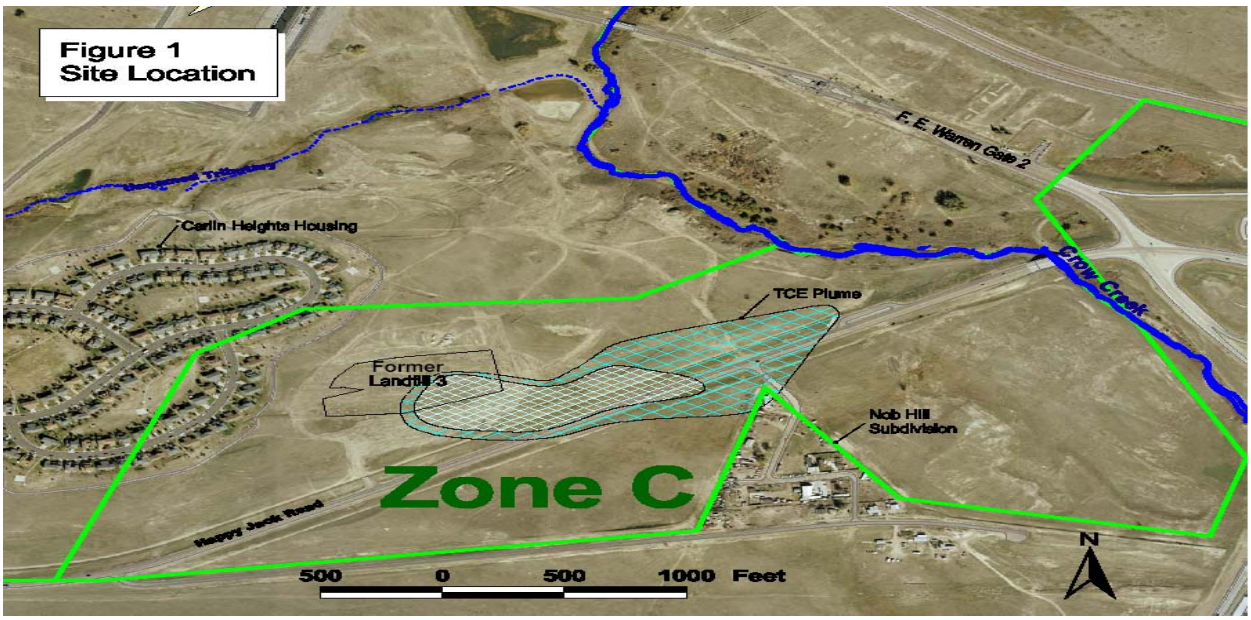
For more information, see the F. E. Warren Information Repository at the following location:

Laramie County Library
2800 Central Avenue
Cheyenne, Wyoming

Phone: (307) 634-3561

Hours: Mon-Thur
10:00 am to 9:00pm
Fri-Sat
10:00 am to 6:00 pm

Information summarized here can be found in greater detail in the Remedial Investigation (RI) Report completed in 2002, the Feasibility Study (FS) Report finalized in 2000, and the SFS report completed in 2003, as well as other documents contained in the Information Repository (IR) for this site. The USAF, EPA, and WDEQ encourage the public to review these documents to gain a more complete understanding of the site and Superfund activities. The IR for FEW is located at the Laramie County Library in Cheyenne, Wyoming.



SITE HISTORY

LF3 was located in the central portion of Zone C (Figure 1). LF3 operated from the mid-1950s through the mid-1960s. Refuse from FEW shops and housing was disposed at LF3 during its operation. Most of the refuse at LF3 had been burned before burial. LF3 was first identified as a site that might pose a hazard to human health or the environment in the mid-1980's. Since that time, numerous investigations have been conducted to define the source, nature and extent of contamination at this site.

The first step in dealing with contamination from LF3 was providing municipal water to residents of Nob Hill in 1997. The next step was to dig out all of the contents of LF3 for a clean closure. The third and final step is addressing contaminated groundwater. This final step incorporates the earlier actions.

SITE CHARACTERISTICS

The USAF conducted a Remedial Investigation (RI) Study and a follow-on Feasibility Study (FS) for Zone C under the oversight of EPA and WDEQ during 1999 and 2000. The RI identified the types, quantities and locations of contaminants and the FS developed ways to address the contamination problem. The RI indicated that:

- Zone C surface geology is composed of unconsolidated alluvial deposits of interbedded clay, silt, sand, gravel and cobbles. The deposits comprise the upper part of the High Plains aquifer at FEW. Depth to the water table within Zone C is variable, ranging from about 31 feet on the west of LF3 to less that 2 feet near Crow Creek.

- Within Zone C, subsurface soils are contaminated with low concentrations of volatile organic compounds (VOCs), polychlorobipheynyls, and selected semi-volatile organic compounds (SVOCs) that can be attributed to waste management activities at Zone C. Surface and subsurface soils are also contaminated with low concentrations of metals, organochlorine pesticides, and SVOCs.

- A plume of groundwater contaminated with chlorinated VOCs originates in the south-central portion of the footprint of LF3 and extends east-northeast approximately one-half mile, toward Crow Creek. Trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and trans-1,2-DCE were the most frequently detected organic compounds, with maximum concentrations of 100 micrograms per liter (µg/L), 129 µg/L, and 5.7 µg/L, respectively. The maximum contaminant levels (MCLs) under the Safe Drinking Water Act (SDWA) for TCE, cis-1,2-DCE and trans-1,2-DCE are 5, 70, and 100 µg/L, respectively. The contamination is relatively shallow, with a maximum depth of contamination approximately 40 feet below ground surface (bgs). Figure 1 shows the TCE plume and general site layout.

- Fate and transport modeling indicates that the groundwater contaminant plume will probably not impact Crow Creek in the future at levels above MCLs.

SUMMARY OF SITE RISKS

As part of the RI, a baseline human health risk assessment and ecological risk assessment were performed to determine if contaminants in Zone C present unacceptable risks to human health or the environment. The baseline risk assessment identified no quantifiable risk within Zone C. However, since shallow groundwater is used for drinking water and agriculture immediately off base actions to restore the groundwater to MCLs are required. Two contaminants attributable to site activities, TCE and cis-1,2-DCE, were detected in concentrations exceeding MCLs.

REMEDIAL ACTION OBJECTIVES

The NCP (National Oil and Hazardous Substances Contingency Plan; 40 CFR Part 300) states the expectation that groundwater will be restored to beneficial use. The remedial action objectives for this site are to:

- Restore the aquifer to drinking water standards.

- Eliminate potential exposure to contaminated groundwater with VOC concentrations greater than drinking water standards.

- Minimize contaminant migration to the surface water to levels that ensure the beneficial use of this resource.

- Prevent exposure to unacceptable concentrations of VOCs in indoor air if future construction occurs over the plume.

Based on these objectives, the preliminary remediation goals (PRGs) for this site are 5 µg/L for TCE, and 70 µg/L for cis 1-2-DCE. These are the drinking water MCLs for these contaminants and are protective of human health.

SCOPE AND ROLE OF THE PREFERD REMEDY

Response actions at FEW are managed within five geographically defined zones (A through E). Each zone includes one or more operable units which address source areas, landfill contents, and groundwater, or in some cases just one of these media. There are presently 13 defined operable units on FEW. Early response actions have been used to address some of the historic landfills, such as the removal by which Landfill 3 was excavated. This action in this proposed plan would amend the fourth final

Record of Decision (ROD) at FEW. Three additional final RODs are currently pending (Zone A, Landfill 4, and Landfill7). Following these will be source areas and groundwater in Zone D and the Open Burn Open Detonation Area and Spill Site 1, 3, 5, and 6 in Zone E. Investigative actions have also begun in the closed Firing Ranges located in the northern part of the base and some small miscellaneous areas not previously investigated.

SUMMARY OF REMEDIAL ALTERNATIVES

The revised remedial alternatives for the Zone C groundwater are presented below. The alternatives are numbered to correspond with the alternatives presented in the FS (USAF 2003). The costs and time to achieve RAOs are presented in the following alternative summaries. Alternative 3 in the FS was the original remedy. Since this remedy has been deemed unfeasible, it was not carried through in the alternatives review.

Common Elements. All of the alternatives presented would result in groundwater concentrations remaining above health-based levels during the treatment period. Therefore, EPA mandates a site review no less often than every 5 years (i.e., the 5-year review).

Additionally, all of the alternatives will be subject to Institutional Controls (ICs). ICs add to the protectiveness of these alternatives by restricting access and exposure to contaminants at Zone C.

Alternative 1 Monitored Natural Attenuation (MNA)

Estimated Capital Cost:	$ 0
Estimated O&M Cost:	$6,000,000
Estimated Present Worth Cost:	$3,400,000
Estimated Time to Achieve RAOs:	50 years

Alternative 1 would rely on natural processes such as dispersion, adsorption, and volatilization to reduce contaminant concentrations in groundwater to below MCLs.

A network of monitoring wells would be sampled to confirm decreasing TCE concentrations. The monitoring program would be implemented until the RAOs are achieved (an estimated 50-years). Data collected would be utilized to monitor contaminant migration, validate conclusions, monitor temporal and spatial trends, insure protection of Crow Creek, and evaluate the overall effectiveness of the MNA process as it relates to Zone C.

Alternative 2 In-situ Treatment of High Concentration Intermediate Zone with MNA

Estimated Capital Cost:	$ 600,000
Estimated O&M Cost:	$3,900,000
Estimated Present Worth Cost:	$3,400, 000
Estimated Time to Achieve RAOs:	30 years

Alternative 2 utilizes in-situ treatment for the intermediate zone and MNA for impacts in the shallow zone. By combining these two technologies a reduction of 20 years in remediation time is predicted over Alternative 1. The in-situ treatment component of the remedy consists of delivery of a chemical oxidant, potassium permanganate ($KMnO_4$), to contaminated media (groundwater or soil) to destroy the contaminants or convert them to innocuous compounds commonly found in natural settings. Only the intermediate aquifer zone within the contaminated area of Zone C will receive in-situ treatment. The shallow layer will be allowed to naturally attenuate. The depth of the intermediate zone is estimated to be 30 to 55 ft bgs (below ground surface). Additional tests will be completed during the final design phase to refine the

requirements for implementing this technology at Zone C.

Under this alternative no groundwater would be treated at surface however, multiple injections may be necessary to achieve MCLs in the intermediate zone.

Alternative 4 Groundwater Extraction of High Concentration Intermediate Zone with MNA

Estimated Capital Cost: $ 300,000
Estimated Annual O&M Cost: $4,600,000
Estimated Present Worth Cost: $3,600,000
Estimated Time to Achieve RAOs: 30 years

Alternative 4 would extract and treat the intermediate zone of groundwater with a system to remove the VOCs. As in Alternative 2, the shallow groundwater would rely on monitored natural attenuation. Water extracted from the intermediate zone would be treated by a proven technology. The treatment technology would be selected during the remedial design process.

Treated groundwater would be discharged to surface downgradient of Nob Hill, reinjected into the aquifer, or discharged to a publicly owned treatment works. The effluent discharge option would also be selected during the remedial design process.

EVALUATION OF ALTERNATIVES

In accordance with EPA guidance, the nine criteria listed in Table 1 are used to evaluate the different alternatives individually and against each other to select a remedy.

TABLE 1 – EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Threshold Criteria – Criteria must be met before an alternative can be considered as a remedy	**Overall Protection of Human Health and the Environment** describes how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
	Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
Balancing Criteria – Relative tradeoffs between different criteria are evaluated	**Long-Term Effectiveness and Permanence** considers the ability of an alternative to maintain protection of human health and environment over time.
	Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
	Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
	Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
	Costs includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to –30 percent.
Modifying Criteria – Evaluate whether remedy is supported by state and community after the public comment period	**State/Support Agency Acceptance** considers whether the State agrees with or opposes the preferred alternative. WDEQ reviews and comments upon all important documents throughout the process.
	Community Acceptance considers whether the local community agrees with or opposes the preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The evaluation of the alternatives is discussed below.

1. Overall Protection of Human Health and Environment

All alternatives are protective of human health and the environment.

Alternative 1, MNA, provides minimal protection in that no unacceptable risk has been identified and concentrations of TCE would be reduced over a longer period of time. Protection would be achieved through LTM of contaminants in groundwater.

Alternative 2, In-Situ Treatment and MNA, provides maximum protection of human health and the environment through active in-situ treatment of the contaminants in the intermediate depth groundwater followed by passive reduction of concentrations in the shallow groundwater. The respective treatments for the intermediate and shallow zones will be implemented until the groundwater in each zone meets MCLs.

Alternative 4, Groundwater Extraction, Treatment and MNA, provides maximum protection of human health and the environment by removing and actively treating the contaminants in a portion of the groundwater followed by passive reduction of concentrations to MCLs.

Institutional controls will be implemented to add to the protectiveness of these alternatives. These controls will provide a managerial means of restricting access and exposure to contaminants.

2. Compliance with ARARs

The key applicable or relevant and appropriate requirements (ARARs) for the evaluated alternatives would be MCLs and the substantive requirements of National Pollutant Discharge Elimination System (NPDES) and granular activated carbon (GAC) disposal. Alternative 1 would eventually comply with MCLs. Alternative 2 would be continued until MCLs are reached. Alternative 4 would also be continued until MCLs are reached. In addition this alternative would require meeting the substantive requirements of an NPDES permit and requirements for GAC disposal.

3. Long-Term Effectiveness and Permanence

Alternative 1, MNA, provides long-term effectiveness by reducing the contaminant concentrations to acceptable levels, although it would occur over a longer period of time. The effectiveness would be verified by long-term monitoring, which provides a control through management of the plume.

Alternative 2 provides a high degree of long-term effectiveness and permanence by using an active treatment technology to reduce risks. However, there is some potential for minimal residual risk associated with the uncertainty in complete distribution of chemicals and reaction with all of the TCE mass.

Alternative 4 provides the highest degree of long-term effectiveness and permanence through removal and active treatment technologies to reduce risks. However, there is some potential for minimal residual risk. Alternative 4 actively extracts and treats the contaminated groundwater treatment for a period of 10 years. Extraction and GAC treatment of contaminated groundwater would have a treatment residual (spent carbon) that would be removed from the site and regenerated or disposed of off site.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

Alternative 4 would most effectively reduce the toxicity, mobility, and volume of contaminants in groundwater. This alternative includes treatment processes that remove the contaminants from groundwater. Alternative 4 involves extracting the contaminated groundwater and adsorption of the contaminants onto GAC. The GAC would be a contaminated residual; however, the GAC is easily removed and contaminants destroyed as part of the regeneration or offsite disposal process. Alternative 2 would also effectively reduce the toxicity, mobility, and volume. Alternatives 2 and 4 rely on natural processes to achieve reductions of concentrations to 5 µg/L after initial treatment. Alternative 1 relies entirely on natural processes to reduce the contaminant concentrations.

5. Short-Term Effectiveness

Alternative 1 involves no construction of a treatment system and would result in no short-term impacts to the community, workers, or the environment.

Alternative 2 would have minimal short-term impacts during implementation, which involves installing 76 piezometers and chemical handling.

Alternative 4 would have short-term impacts during implementation. Alternative 4, which involves installing four wells, an aboveground treatment system, and discharge line to surface discharge, would have few short-term impacts due to construction activities for this alternative.

Alternatives 2 and 4 would achieve the RAOs in the shortest period of time (30 years) as compared to Alternative 1, which would achieve the RAOs in 50 years.

6. Implementability

Alternative 1, MNA, is very easy to implement because no construction of a treatment system is required and O&M would be minimal.

Alternative 2 is easy to implement. Conventional and readily available drilling equipment and chemicals would be used. In-situ treatment has been tested and optimized over the years. It can be considered an innovative technology and its applicability is very site-specific. Minimal performance data exist for full-scale applications, although in-situ chemical treatment has been used effectively for treatment of smaller scale "hot spot" sites.

Alternative 4 is moderately easy to implement. Conventional and readily available equipment and materials would be used. GAC treatment is a proven technology and easy to operate and maintain. Offsite regeneration, disposal, and replacement services for the spent carbon are readily available.

7. Costs

Alternative 1 has the lowest capital costs, and Alternative 2 has the highest capital cost due to installation of 76 groundwater injection wells and chemical treatment.

The NPV costs, excluding institutional controls, range from $3.4 million to $3.6 million. Alternatives 1 and 2 have the lowest NPV cost of $3.4 million. Alternative 4 has the highest NPV cost of $3.6 million.

8. State/Support Agency Acceptance

EPA and the State of Wyoming support the preferred alternative.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for the site.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 2, in-situ treatment combined with MNA, is the technology being selected for use at Zone C to address groundwater impacts.

The MNA component of this remedy uses natural attenuation processes to achieve remediation objectives with a comprehensive monitoring program. Monitoring results will be used to calculate the rate of natural attenuation occurring at Zone C, which will then be compared to contaminant removal rates estimated from previously obtained site characterization data and groundwater modeling predictions.

By combining in-situ treatment with MNA a reduction of 20 years in remediation time is predicted over MNA alone. The in-situ treatment component of the remedy will consist of delivery of a chemical oxidant, potassium permanganate ($KMnO_4$), to contaminated media (groundwater or soil) to destroy the contaminants or convert them to innocuous compounds commonly found in natural settings.

Only the intermediate aquifer zone within the contaminated area of Zone C will receive in-situ treatment. The shallow layer will be allowed to naturally attenuate. The depth of the intermediate zone is estimated to be 30 to 55 ft bgs (below ground surface).

A pilot-scale treatability study evaluating the efficacy of in-situ treatment is currently being conducted at Zone D. Preliminary results from this study indicate that in-situ treatment using potassium permanganate is a feasible technology to treat TCE-contaminated groundwater at FEW. Additional tests will be completed during the final design phase to refine the requirements for implementing this technology at Zone C.

COMMUNITY PARTICIPATION

The USAF, EPA and WDEQ provide information regarding the cleanup of FEW to the public through public meetings, the AR for the site, newsletters and direct mailings to interested parties and announcements published in the Wyoming Tribune-Eagle. The USAF, EPA and WDEQ encourage the public to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted at the site. The dates for the public comment period; the date, location, and time of the public meeting; and the locations of the AR files are provided on the front page of this Proposed Plan.

For additional information on Zone C, please contact:

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GLOSSARY OF TERMS

Specialized terms used in this Proposed Plan are defined below:

Applicable or relevant and appropriate requirements (ARARs) **–** the federal and state environmental laws that a selected remedy will meet. These requirements may vary among sites and alternatives.

Contaminant plume – a column of contamination with measurable horizontal and vertical dimensions that is suspended in and moves with groundwater.

Ex situ – the removal of a medium (for example, water or soil) from its original place, as through excavation, in order to perform the remedial action.

Groundwater – underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

In-Situ – leaving a medium (for example, water or soil) in its original place to perform the remedial action.

Monitoring – ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action.

Long-term monitoring – physical and chemical measurements over time to evaluate performance

Operations and maintenance – running the treatment system and doing needed repairs.

Organic compounds – carbon compounds, such as solvents, oils, and pesticides. Most are not readily dissolved in water. Some organic compounds can cause cancer.

Present worth analysis – a method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. When calculating present worth cost for Superfund sites, total operations and maintenance costs are to be included.

Revegetate – to replace topsoil, seed, and mulch on prepared soil to prevent wind and water erosion.

Maximum contaminant level (MCL) – the maximum permissible level of a contaminant in water that is delivered to any user of a public water system under the Safe Drinking Water Act.

Remedial Action Objectives (RAO) – the stated objectives for the site

Administrative Record (AR) – a record of all documents, correspondence for the Restoration Management Program

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for Zone C is important to the USAF. Comments provided by the public are valuable in helping the USAF select a final cleanup remedy for the site.

You may use the space below to write your comments, then fold and mail. Comments must be postmarked by 8 April 2004**.** If you have any questions about the comment period, please contact John Wright at (307) 773-4147. Those with electronic communications capabilities may submit their comments to the USAF via the Internet to: john.wright@warren.af.mil.

Name _____

Address _____

City _____

State _____ **Zip** _____